Listing of Claims

This listing of claims replaces all previous listings and versions of the claims.

What is claimed is:

1. (Currently Amended) A method of preparing a carbon doped silicon oxide (CDO) film on a substrate, the method comprising:

(a) providing the substrate to a deposition chamber; and

(b) contacting the substrate with one or more CDO precursors having a carbon-carbon triple bond under process conditions whereby the CDO film is formed on the substrate, and whereby the CDO film contains carbon-carbon triple bonds and their derivative bonds,

wherein the CDO precursor comprises one or more compounds selected from the group consisting of Ethynyltrimethylsilane (ETMS), also known as trimethylsilaneacetylene (TMSA), Propargyltrimethylsilane (PTMS), Propargyloxytrimethylsilane (POTMS), Bis(trimethylsilyl)acetylene (BTMSA), 1,3-Diethynyltetramethyldisiloxane (DTDS), Dimethylmethoxysilaneacetylene (DMMOSA), Methyldimethoxysilaneacetylene (MDMOSA), Dimethylethoxysilaneacetylene (DMEOSA), Methyldiethoxysilaneacetylene (MDEOSA), Ethyldiethoxysilaneacetylene (EDEOSA), Dimethylsilane-diacetylene (DMSDA), Methylsilane-triacetylene (MSTA), and Tetra acetylene silane (TAS).

2. (Original) The method of claim 1, wherein the CDO film has carbon-carbon triple bonds or their derivative forms in sufficient amounts that the CDO film has a compressive stress or a tensile stress of magnitude not greater than about 50 MPa and a dielectric constant of not greater than about 3.

3. (Original) The method of claim 1, wherein the CDO film has carbon-carbon triple bonds or their derivative forms in sufficient amounts that the CDO film has a compressive stress or a tensile stress of not greater than about 30 MPa.

4. (Original) The method of claim 1, wherein the substrate is a partially fabricated integrated circuit.

5. (Original) The method of claim 3, wherein the CDO film is an interlayer dielectric in an integrated circuit.

6. (Original) The method of claim 1, wherein the deposition chamber comprises one or multiple stations that allow processing one or multiple substrates in parallel.

7. (Original) The method of claim 1, wherein the CDO film is formed on the substrate by a chemical vapor deposition process.

8. (Original) The method of claim 1, wherein the CDO film is formed on the substrate by a spin coating process.

9. (Original) The method of claim 1, wherein the CDO film is formed on the substrate by a plasma enhanced chemical vapor deposition (PECVD) process.

10. (Original) The method of claim 1, wherein contacting the substrate involves contacting with only a single CDO precursor in a carrier gas.

11. (Original) The method of claim 10, wherein the single CDO precursor has at least two carbon-silicon bonds.

12. (Original) The method of claim 10, wherein the CDO precursor contains silicon and oxygen atoms.

13. (Canceled)

14. (Canceled)

15. (Original) The method of claim 1, further comprising contacting the substrate with one or more secondary precursors selected from the group consisting of 1,3-Divinyltetramethyldisiloxane (DVDS), Vinyltrimethylsilane (VTMS), Vinylmethyldimethoxysilane (VMDMOS), and Divinyldimethylsilane (DVDMS).

16. (Original) The method of claim 1, wherein contacting the substrate involves contacting the substrate with only a primary CDO precursor and a secondary CDO precursor in a carrier gas.

17. (Original) The method of claim 16, wherein the primary CDO precursor is an alkylsiloxane and the secondary CDO precursor comprises a carbon-carbon triple bond.

18. (Original) The method of claim 17, wherein the secondary CDO precursor is a hydrocarbon that also serves as a carrier gas.

19. (Original) The method of claim 16, wherein the primary CDO precursor comprises an alkyl cyclotetrasiloxane.

20. (Original) The method of claim 1, wherein the one or more CDO precursors are provided in a carrier gas.

21. (Original) The method of claim 16, wherein the carrier gas comprises one or more oxygen containing gases selected from the group consisting of carbon dioxide, oxygen, ozone, hydrogen peroxide and nitrous oxide.

22. (Original) The method of claim 16, wherein the carrier gas comprises one or more gases selected from the group consisting of helium, argon, and other inert gases.

23. (Original) The method of claim 16, wherein the carrier gas comprises one or more hydrocarbon gases.

24. (Original) The method of claim 23, wherein the one or more hydrocarbon gases are selected from the group consisting of acetylene (C_2H_2), ethylene (C_2H_4), propene (CH_2=$CHCH_3$), propyne ($CH_3C{\equiv}CH$), 1,2-propadiene (CH_2=C=CH_2), and cyclopropene (C3H4).

25 (Original) The method of claim 16, wherein the carrier gas comprises one or more gases selected from the group consisting of oxygen containing gases, inert gases, and hydrocarbon gases.

26. (Original) The method of claim 1, wherein the deposited CDO film has a carbon-carbon triple bond to silicon oxide bond area ratio of about 0.05% to 20% based on FTIR peak area.

27. (Original) The method of claim 1, wherein the CDO film has a carbon-carbon triple bond to silicon oxide bond area ratio of about 0.3% to 7% based on FTIR peak area.

28. (Original) The method of claim 27, where the as deposited CDO film also contains derivative bond structures of carbon-carbon triple bonds, wherein the derivative bond structures include one or more of the following: carbon-carbon double bonds, carbon-carbon single bonds, and their crosslinked forms within the Si-O-Si matrix.

29. (Currently Amended) A method of preparing a carbon doped silicon oxide (CDO) film on a substrate, the method comprising:

(a) providing the substrate to a plasma enhanced chemical vapor deposition (PECVD) deposition chamber;

(b) forming a plasma in the deposition chamber; and

(c) introducing an oxygen-containing carrier gas and one or more CDO precursors having a carbon-carbon triple bond, to the deposition chamber under process conditions whereby the CDO film is formed on the substrate,

whereby the CDO film contains carbon-carbon triple bonds or their derivative forms in sufficient amounts that the CDO film has a compressive stress or a tensile stress of not greater than about 50 MPa and a dielectric constant of not greater than about 3, and

wherein the deposited CDO film has a carbon-carbon triple bond to silicon oxide bond area ratio of about 0.3% to 7% based on FTIR peak area.

30. (Original) The method of claim 29, wherein the carrier gas comprises one or more oxygen containing gases, such as carbon dioxide, oxygen, ozone, hydrogen peroxide and nitrous oxide.

31. (Original) The method of claim 29, wherein the carrier gas comprises one or more gases selected from the group consisting of helium, argon and other inert gases.

32. (Original) The method of claim 29, wherein the CDO precursor comprises one or more compounds selected from the list consisting of Ethynyltrimethylsilane (ETMS), also known as trimethylsilaneacetylene (TMSA),Propargyltrimethylsilane (PTMS), Propargyloxytrimethylsilane (POTMS), Bis(trimethylsilyl)acetylene (BTMSA), 1,3-Diethynyltetramethyldisiloxane (DTDS), Dimethylmethoxysilaneacetylene (DMMOSA), Methyldimethoxysilaneacetylene (MDMOSA), Dimethylethoxysilaneacetylene (DMEOSA), Methyldiethoxysilaneacetylene (MDEOSA), Ethyldiethoxysilaneacetylene (EDEOSA), Dimethylsilane-diacetylene (DMSDA), Methylsilane-triacetylene (MSTA), and Tetra acetylene silane (TAS).

33. (Original) The method of claim 29, further comprising introducing a secondary precursor into the deposition chamber, wherein the secondary precursor is selected from the list consisting of 1,3-Divinyltetramethyldisiloxane (DVDS), Vinyltrimethylsilane (VTMS), Vinylmethyldimethoxysilane (VMDMOS), and Divinyldimethylsilane (DVDMS).

34-44. (Canceled)

45. (Currently Amended) A method of preparing a carbon doped oxide dielectric (CDO) film comprising an improved Si-O-Si backbone structure, the method comprising:

a) providing a substrate to a deposition chamber; and

b) contacting the substrate with one or more dielectric film precursors under process conditions to form the dielectric film on the substrate, whereby the dielectric film contains a Si-O-Si network having a matrix structure with enhanced rigidity to lower the tensile stress commonly associated with carbon doped oxide dielectric films, wherein the Si-O-Si backbone structure possesses an average bond angle of less than approximately 145 degrees, and a stretching vibration peak position at wavenumber of less than 1100 cm^{-1} on FTIR spectrum <u>and the CDO film has a carbon-carbon triple bond to silicon oxide bond ratio of about 0.3% to 7% based on FTIR peak area</u>.

46-48. (Canceled)

49. (Original) The method of claim 45, wherein the CDO film contains elements other than Si, O, C and H.

50. (Original) The method of claim 48, where the as deposited CDO film also contains derivative bond structures of carbon-carbon triple bonds, wherein the derivative bond structures include one or more of the following: carbon-carbon double bonds, carbon-carbon single bonds, and their crosslinked forms within the Si-O-Si matrix.

51. (Original) The method of claim 45, wherein the carbon doped oxide dielectric film has a compressive stress or a tensile stress of magnitude not greater than about 50 MPa and a dielectric constant of not greater than about 3.